

EXHIBIT E

(10) **Patent No.:** US 6,791,757 B2
(45) **Date of Patent:** Sep. 14, 2004

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(57) **ABSTRACT**

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Related U.S. Application Data

(63) Continuation-in-part of application No. 09/615,011, filed on Jul. 12, 2000.

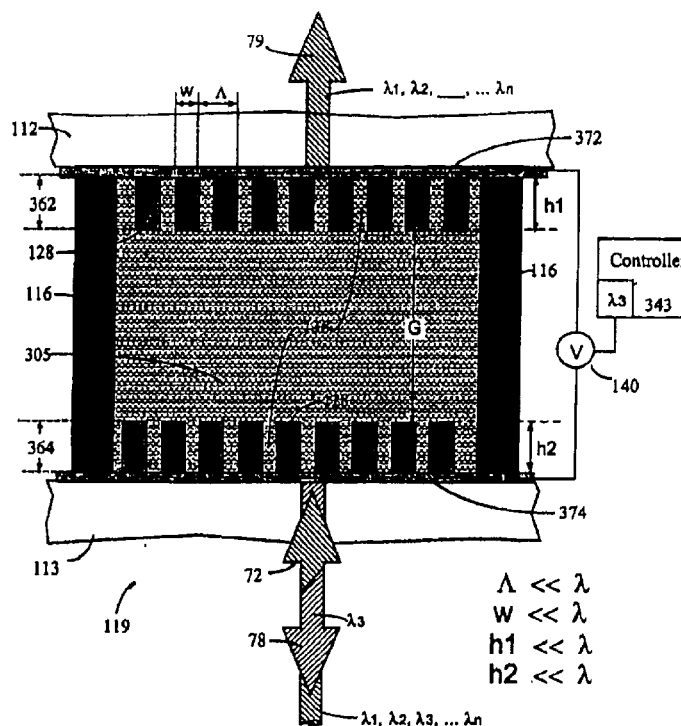
(60) Provisional application No. 60/310,399, filed on Aug. 6, 2001.

(51) Int. Cl.⁷ G02B 27/00

(52) U.S. Cl. 359/578; 359/579; 359/260;
359/261; 359/315; 359/318; 359/247; 349/198

(58) **Field of Search** 359/247, 250,
359/252-253, 260-261, 315-318, 321,
578, 579; 349/198

30 Claims, 26 Drawing Sheets





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(12) **United States Patent**
Hobbs et al.

(10) **Patent No.:** **US 6,870,624 B2**
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(54) **OPTICAL WAVELENGTH RESONANT
 DEVICE FOR CHEMICAL SENSING**

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(*) Notice: Subject to any disclaimer, the term of this
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 U.S.C. 154(b) by 362 days.

(21) Appl. No.: **10/001,069**

(22) Filed: **Oct. 30, 2001**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 60/244,312, filed on Oct. 30,
 2000, provisional application No. 60/283,314, filed on Apr.
 12, 2001, and provisional application No. 60/310,399, filed
 on Aug. 6, 2001.

(51) Int. Cl.⁷ **G01N 21/25; G01N 21/47**

(52) U.S. Cl. **356/416; 356/440; 422/82.05**

(58) **Field of Search** 356/402, 416,
 356/440; 422/82.05, 68.1; 359/573, 569,
 565

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Primary Examiner—Gregory J. Toatley, Jr.

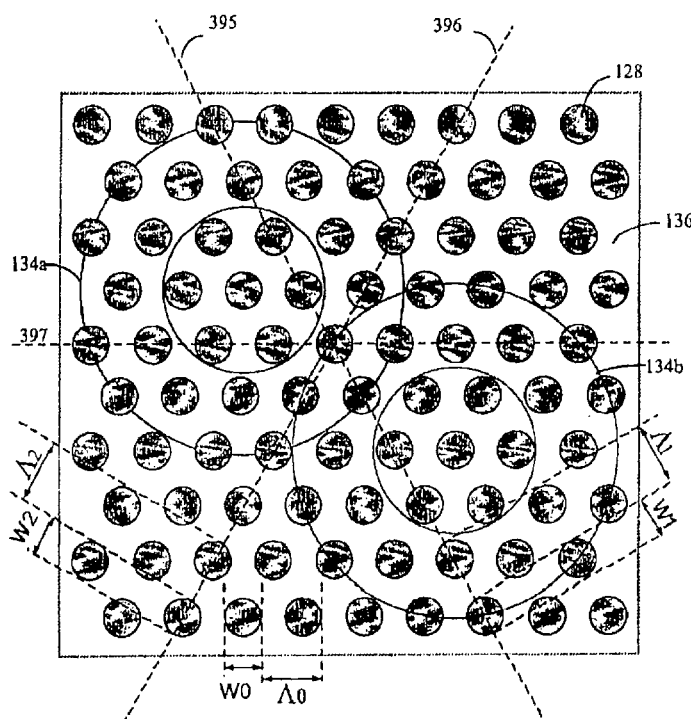
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(57) **ABSTRACT**

An apparatus for filtering electromagnetic waves, the appa-
 ratus comprising a substrate having a surface relief structure
 containing at least one dielectric body with physical dimen-
 sions smaller than the wavelength of the filtered electro-
 magnetic waves, such structures repeated in a two dimen-
 sional array covering at least a portion of the surface of the
 first substrate. Also disclosed is a material sensor utilizing
 this apparatus.

25 Claims, 14 Drawing Sheets



$$W_0 = W_1 = W_2$$

$$\Lambda_0 = \Lambda_1 = \Lambda_2$$

$$\Lambda \ll \lambda$$

$$W \ll \lambda$$